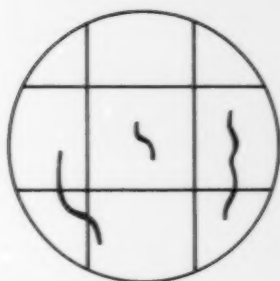

THE CONTROL AND MANAGEMENT OF FRIABLE ASBESTOS MATERIALS



Guidelines for identifying and controlling
the hazards associated with friable
asbestos-containing building materials



Province of British Columbia
Ministry of Labour

OCCUPATIONAL ENVIRONMENT BRANCH
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Control and management of friable asbestos materials

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TABLE OF CONTENTS

	Preface	
1.0	Introduction	3
2.0	Sampling of Suspected Asbestos Containing Materials	3
	2.1 Precautions	3
	2.2 Sampling Procedure	4
3.0	Bulk Sample Analysis — Laboratory Report	4
4.0	Exposure Assessment	4
	4.1 Condition of Material	6
	4.2 Accessibility and Activity Level	6
	4.3 Friability	6
	4.4 Air Plenum or Direct Air Stream	6
	4.5 Asbestos Content	6
	4.6 Rating Scheme	6
	4.7 Decision Guide	6
5.0	Temporary Control Measures	6
6.0	Acceptable Control Measures — Long Term	7
	6.1 Removal	7
	6.2 Encapsulation	7
	6.2.1 Is Encapsulation an Appropriate Control Measure?	7
	6.3 Enclosure	7
7.0	Removal Procedure	10
	7.1 Wet Removal	10
	7.1.1 Precautions and Preparations	10
	7.1.2 Stripping Procedure	10
	7.1.3 Cleanup Procedure	11
	7.2 Dry Removal	11
	7.3 Encapsulation Procedure	11
	7.3.1 Precautionary Measures	11
	7.3.2 Post-Encapsulation Measures	12
	7.4 Enclosure Procedure	12
	7.4.1 Precautionary Measures	12
	7.4.2 Post-Enclosure Measures	12
8.0	Decontamination Procedure	13
	8.1 Decontamination Areas	13
	8.2 Decontamination Sequence	13
9.0	Transport & Disposal of Asbestos-Containing Refuse	13
Appendix A	Protective Equipment	14
	A.1 Respiratory Protection	14
	A.2 Other Protective Equipment	14
Appendix B	Sealants	15
	B.1 Types of Sealants	15
	B.2 Sealant Characteristics	15
Appendix C	Directory	16

Preface

These guidelines were prepared by the Committee on Asbestos Hazards in Public Buildings in response to concerns over potential health risks resulting from the use of asbestos building materials in the province. The committee was made up of representatives from the provincial Ministries of Labour, Education, Health and the Workers' Compensation Board.

A serious exposure problem can occur in all types of buildings in which certain asbestos-containing materials have been used for fireproofing, insulation or decoration. Asbestos fibres can be released from these materials, contaminating the building environment. Individuals who inhale or ingest asbestos fibres could develop lung cancer or cancers of other parts of the body.

Hard asbestos-containing materials (such as vinyl/asbestos floor tiles or asbestos/cement pipes) do not generally create exposure problems. Care must be taken when cutting or grinding them, but this guidance document is not concerned with those types of material. (Neither does this document address the subject of pipe and boiler lagging that contains asbestos.)

Soft or loosely bound (i.e., **friable**) asbestos-containing materials can release asbestos fibres following only minor disturbance to the material. It is these soft asbestos-containing materials that can cause contamination and exposure problems to which these guidelines apply.

On the basis of the committee's investigation, it is clear that there is no source of accurate records by which to easily identify those buildings that now contain asbestos material. Identification of locations with asbestos will be dependent on the initiative of building owners and occupants, contractors and building service personnel. These guidelines are intended to provide a systematic approach for the identification, evaluation, maintenance and control of friable asbestos materials in buildings.

1.0 INTRODUCTION

Asbestos is the term used to identify a group of naturally occurring, fibrous, mineral silicates. Asbestos types are differentiated by fibre size and structure, **chrysotile** (white asbestos) being the most commonly used. **Amosite** (brown asbestos) and **crocidolite** (blue asbestos) are other forms of asbestos used in lesser quantities.

Asbestos has been used as a major component in some sprayed-on fireproofing, insulating and acoustical materials. The integrity of the material containing asbestos may be affected by many factors, leading to the release of airborne fibres. Workers performing maintenance duties may contact these surfaces, causing asbestos fibre release. Other physical abuse and general deterioration due to aging can, similarly, lead to airborne asbestos fibres. In addition, air movement from ventilation systems or overhead heaters may dislodge fibres from sprayed-on material.

The adverse health effects associated with the inhalation of asbestos fibres have been well documented. They include asbestosis (a debilitating lung disease), lung cancer and mesothelioma (cancer of the lining of the chest or abdominal cavity). Typically, the symptoms of these diseases develop after an extended latency period of from 15 to 35 years following initial exposure. The risk of developing lung cancer associated with asbestos exposure is greatly increased by smoking. Occupational exposure limits for airborne asbestos fibres have been mainly directed to the prevention of asbestosis among workers. It is not clear what degree of protection, if any, they provide against lung cancer or mesothelioma. In fact, despite extensive research, there is currently no scientific consensus as to whether there is any "safe" level of exposure.

These guidelines identify standards of good practise based on current reliable information in this field. It is important to emphasize that these guidelines do not address the question of individual exposure to airborne asbestos fibres but rather, outline procedures for evaluating the probability of asbestos fibre release in a building or facility and identifying the corresponding control measure to minimize fibre release.

The degree of health hazard in areas where sprayed or trowelled asbestos-containing material is found depends upon its accessibility, condition, friability, contact with air currents and the amount and type of asbestos in the material. Those six factors must be assessed to evaluate the potential for asbestos fibre release from the surface, and hence the health hazard potential.

Based on the potential hazard, a decision must be made as to the necessity for and extent of control measures. Alternative long-term control measures are: removal, enclosure or encapsulation of the asbestos containing material.

Some control measures may be appropriate in certain circumstances but inappropriate for others. Primary consideration must be given to the health of the workers instituting the controls and to the health of those who

will occupy the area upon completion of the job. It is therefore necessary to follow stringent work procedures and to adopt proper techniques, as outlined in these guidelines.

The potential for asbestos fibre release can only be determined by identifying the nature and extent of asbestos present and by evaluating the factors that are likely to contribute to fibre release.

Monitoring of airborne asbestos fibres (i.e., air sampling and fibre counting) is not a reliable technique for determining the potential for asbestos fibre release. However, during implementation of control procedures, the use of air sampling may be appropriate. Where experience is lacking with regard to expected fibre levels, monitoring can provide guidance for proper respirator selection. Monitoring can also be used as a means to determine if cleanup and decontamination procedures were properly executed. Air monitoring may also be appropriate to determine if contamination of areas adjacent to the work area has occurred.

NOTE: Friable asbestos material was used for many years in pipe and boiler lagging and covering. These materials do not create an exposure hazard unless the friable insulation material is exposed and damaged. Pipe and boiler lagging and covering should be routinely inspected. If the insulation material is exposed, re-jacketing the damaged area will prevent asbestos fibre release. The sampling and hazard evaluation program identified in these guidelines does not extend to pipe or boiler lagging.

2.0 SAMPLING OF SUSPECTED ASBESTOS-CONTAINING MATERIAL

Bulk sampling and analysis of suspected asbestos-containing material are extremely important, since the decision to take corrective action will depend, in large part, on the results of the laboratory analysis. Neither visual inspection nor checking building records is adequate to establish the presence or absence of asbestos in sprayed or trowelled material. Suspect material could contain glass fibres, cellulose or non-asbestos mineral fibres.

The sampling procedures outlined below should be followed closely. Improper sampling will result in misleading analyses that could lead to either unnecessary corrective action or to lack of necessary action.

A representative sample should be taken from within the suspect material by penetrating the entire depth of the material since it may have been applied in more than one layer or covered with paint or other protective coating. This kind of sample is called a **bulk sample**. **Bulk sampling and analysis of the friable material itself is the only method to determine what type and percentage of asbestos is present in the material.**

One sample should be taken for each floor or area of material having the same colour and texture. Material of a different appearance should be sampled separately. A

minimum of two samples should be taken for each building.

2.1 Precautions

To avoid causing unnecessary exposure to asbestos fibres, the following precautions should be taken during sampling:

- a) The material should be sampled when the area is not in use.
- b) Only those persons needed for the sampling should be present in the immediate area.
- c) It is recommended that the sampler wear a respirator approved for protection against asbestos dust.
- d) Spray the material with a light mist of water to prevent fibre release during sampling.
- e) The sample container should be held away from the face during actual sampling.
- f) Do not disturb the material any more than necessary.
- g) If pieces of material break off during sampling, wet-clean the floors and areas where they have fallen. Small amounts of material shall be placed in plastic bags, sealed and disposed of in a refuse container.

NOTE: Excessive sampling should be discouraged to avoid unnecessary disturbance of the material.

2.2 Sampling Procedure

Sampling can be performed by building maintenance or safety personnel following these procedures:

- a) Use a small container such as a plastic 35 mm film canister or similar unbreakable jar with screw-on lid. The container should be dry and clean.
- b) Gently twist the open end of the container into the material. A core of the material should fall into the container. A sample can also be taken by using a sharp knife to cut out or scrape off a small piece of material and then placing it into the container. Be sure to penetrate any paint or protective coating and all the layers of the material.
- c) Tightly close the sample container; wipe the exterior of the container with a damp cloth to remove any material which may have adhered to it during sampling. After sampling, the cloth shall be placed in a plastic bag, sealed and disposed of in a refuse container.
- d) Tape the container lid to prevent the accidental opening of the container during shipment or handling.
- e) Label the sample container. This label should identify the building, date the sample was taken, and bear a unique identification (ID) number.
- f) Make a written record of each sample by noting the date the sample was taken, location of material sampled, the area or room sampled, and the sample ID number.
- g) Bulk sampling kits (sampling containers and instruction) are available from the OCCUPATIONAL ENVIRONMENT BRANCH. (The sampling can also be performed by the Occupational Environment Branch inspectional staff.) The samples and completed Bulk Sample Report shall be forwarded to:

OCCUPATIONAL ENVIRONMENT BRANCH MINISTRY OF LABOUR

4946 Canada Way Burnaby, B.C. V5G 4J6

Phone: 291-9494

(The samples will be forwarded to the Industrial Hygiene laboratory of the Workers' Compensation Board.)

The Occupational Environment Branch will advise the parties concerned of the results of the laboratory analysis.

3.0 BULK SAMPLE ANALYSIS - LABORATORY REPORT

It is important that a complete written and signed report of the analytical results be obtained from the laboratory. The laboratory should report the following information for each sample submitted:

- a) The sample identification (ID) number.
- b) The analytical method used to analyze the sample.
- c) (i) A description of the sample appearance.
(ii) Whether the sample was homogenized before analysis. (Asbestos materials were not always uniformly mixed before application. If a sample is not homogenized prior to analysis, some materials present in the sample may not be detected.)
- d) Percent of each type of asbestos present.
- e) Type and amount of the other fibrous materials present in the sample. (The analyst should report what non-asbestos fibrous materials are present in the sample and the percent present, and provide the basis for that judgment. Identification of the other fibres present will minimize the reporting of false results.)
- f) Comments on any other materials present.
- g) Laboratories should include the quality control (QC) procedures followed in their analysis. (A separate QC report is not required for each sample analysed, a single QC report from the laboratory selected is adequate.)

4.0 EXPOSURE ASSESSMENT

If analysis of bulk material establishes the presence of asbestos in the sampled friable material, the potential exposure to building users must be evaluated.

In addition to the information from the laboratory analysis of the bulk sample (providing percentage and type of asbestos) a visual inspection is required in order to assess the potential health hazard associated with the material.

The Occupational Environment Branch will conduct a hazard evaluation and provide building management with recommendations for the most appropriate control strategy.

Material condition, building structure characteristics and human activity are factors that will have significance in any potential exposure situation involving sprayed or trowelled asbestos materials. These factors may act singly or in combination to cause environmental contamination and exposure to building users.

ASBESTOS INSPECTION PROGRAM

BULK SAMPLE REPORT

Name of Building Sampled: _____

Address: _____

Estimated Date of Application: _____

Person in Charge of Building: _____

Contact Person: _____

Telephone Number: _____

Name of Person to Receive these Results: _____

Address: _____

No. of Samples Submitted: _____

Sampling Location	Sample No.	Date Sampled
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RESULTS (for office use only)

Sample Number	Presence of Asbestos	Type	Percentage
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4.1 Condition of Material

Material condition may indicate the extent of contamination and the likelihood of future contamination. This factor is a combination of quality of installation, adhesion of the material to the underlying surface, material deterioration and damage. Delamination or deterioration of the material depends on the characteristics of the material itself (whether it shows signs of aging or loss of cohesive strength). Damage is incurred by either accidental or intentional contact.

Evidence of debris can be a good clue to the condition of material, which may vary from minor deterioration and damage to widespread and severe material disintegration. Water can dislodge, delaminate and disturb asbestos materials that are otherwise in excellent condition. Water can carry fibres to other areas in the building where evaporation will leave a collection of fibres that can become suspended in the air. Water damage will have a significant effect on selection of a corrective method, essentially eliminating encapsulation as a solution.

4.2 Accessibility & Activity Level

If the material is accessible, it is subject to accidental or intentional contact and damage. Therefore, consideration must be given to the proximity of friable material to heating, ventilation, lighting and plumbing systems requiring maintenance or repair, and to activity in the area.

The level of activity in the area is a significant factor to be considered, including the number of workers, length of time spent in the area, and the type of work performed. Air movement, building vibration from machinery or any other source, and activity levels of maintenance personnel may also result in damage to the asbestos material.

4.3 Friability

Asbestos materials can vary in their degree of friability. The more friable, the greater potential for asbestos fibre release and contamination. Sprayed asbestos material is generally more friable than most trowelled materials.

4.4 Air Plenum or Direct Air Stream

Friable asbestos-containing material found within air plenums increases the hazard as fibres may be picked up by the air movement and spread throughout the building.

4.5 Asbestos Content

The percentage for each type of asbestos present should be added together to give the total asbestos content in the material. A high percentage means more fibres can be released to contaminate the building environment.

4.6 Rating Scheme

The following simple scheme can be used as a guide for the evaluation.

It must be stressed that only partial reliance should be placed on these tables and a great deal of judgement on the part of the investigator is required.

Table 4.6.1 Rating Table

Factor	Rating	Description
Accessibility	High (H)	Accessible in high activity areas.
	Medium (M)	Accessible in low activity areas or beyond occupants' reach.
	Low (L)	Enclosed.
Condition	High (H)	Severe damage.
	Medium (M)	Mild-moderate damage.
	Low (L)	Good condition.
Friability	High (H)	Easily breaks apart.
	Medium (M)	Mild-moderate friability.
	Low (L)	Non-friable, firmly bound.

4.7 Decision Guide

4.7.1 Decision Table

	Not in Return Air Plenum		Asbestos present in return air plenum
	Less than 20% Asbestos	Greater than 20%	
Immediate Control	2H's or 3M's	1H or 2M's	control reqd. unless 3L's and less than 20% Asbestos
Control Required	1H or 2M's	1M	
No Control	1M or 3L's	3L's	

Tables reprinted from: Alberta Workers' Health, Safety and Compensation. "Asbestos Control - Sprayed-on Applications", 1981

5.0 TEMPORARY CONTROL MEASURES

During the interval between identification and resolution of an asbestos exposure problem, it may be possible to significantly reduce potential airborne asbestos fibre exposure by control of maintenance, custodial and repair activities. Temporary measures should include alteration of various work procedures such as maintenance or renovation that could potentially cause asbestos contamination. Wet cleaning methods, for example, could be used in place of dry dusting and sweeping in any essential custodial work. In addition, maintenance and custodial workers should be protected by wearing respirators approved for protection against asbestos dust.

Building user and bystander exposure can be reduced substantially by appropriate rescheduling of necessary

custodial and maintenance work. While significant reductions can be achieved by these methods, exposures are not eliminated and the use of such techniques should be temporary.

6.0 ACCEPTABLE CONTROL MEASURES - LONG-TERM

The long-term alternatives to reduce or eliminate asbestos exposure from sprayed or trowelled, friable asbestos materials fall into either of two general categories:

- a) **Removal** of the asbestos material from the structure.
- b) Asbestos **containment** through the use of a sealant (encapsulation) or barrier (enclosure) system.

Removal, encapsulation, and enclosure are corrective methods and can be used separately or in combination. Removal completely eliminates the source of exposure to asbestos and is, therefore, a permanent solution. Both enclosure and encapsulation are containment methods; they are not permanent solutions since the asbestos material remains in the structure. When containment methods are instituted, a recurrence of the problem at a future date can be expected (i.e., at the time of building renovation or demolition).

Selection of the appropriate method or combination of methods will depend upon a number of factors including characteristics of the asbestos material, structure use and configuration, user activity and cost. Table 6.0.1 lists the control alternatives along with the advantages, disadvantages and appropriateness of each method.

6.1 Removal

All the asbestos material is taken off the underlying surface, collected and placed in containers for burial in an approved disposal site. Removal may require interruption of building activities.

As outlined in Section 7, acceptable removal procedures must be followed for both wet and dry alternatives. The wet procedure requires wetting the material prior to removal. Thoroughly wetting asbestos material greatly reduces the release of fibres. Using water that has been amended with a wetting agent (surfactant) is strongly recommended for all removal operations. This ensures greater penetration of the material and reduces the amount of water needed. Dry removal requires special precautions as noted in Section 7.2, page 11.

The original purpose of the material should be considered when a corrective method is chosen. Removed fireproofing material should be replaced with a non-asbestos material which will maintain compliance with fire and building codes. If the asbestos material served either an insulating or acoustical function, a replacement material should have similar characteristics.

6.2 Encapsulation

Encapsulation refers to the coating of asbestos-containing materials with a bonding agent called a

sealant, thereby preventing fibres from being released from the asbestos surface. Encapsulation with sealants may make replacement of sprayed or trowelled asbestos material unnecessary. The use of sealants means retention of the asbestos material and recurrence of the problem if the sealant is damaged or penetrated. In addition, this postpones asbestos control to the time of major renovation or building demolition. The use of sealants may be restricted by characteristics of the sprayed asbestos surface itself. The integrity of an encapsulated surface depends upon bonding between the sprayed asbestos material and supporting structural members. For example, applying a sealant to a sprayed asbestos material having initially poor adhesion to the underlying surface can result in shearing and failure of the full thickness of sprayed material and the applied sealant. Accessibility and user behaviour should also be carefully considered.

Encapsulation should be limited to areas where contact damage will not occur, a factor which may preclude encapsulation in many areas of buildings because of high activity levels.

6.2.1 Is Encapsulation an Appropriate Control Method?

Encapsulation may be a good solution where it is very difficult to remove asbestos. The use of sealants is often considered advisable on hard, rocklike materials (called "cementitious") which contain asbestos. Although these materials typically do not present severe exposure problems, it may be advisable to encapsulate them as an extra precaution.

Encapsulation is an acceptable solution to asbestos exposure problems if the problems are not very severe and meet the criteria for encapsulation described in Table 6.0.1. If asbestos-containing material is not deteriorating, has not been damaged by water, is firmly attached to the underlying surface, is far from the reach of users of the buildings, is less than 1.5 inches (38 mm) thick, then the problem it presents is probably not too severe; in such cases, encapsulation is likely to be a suitable approach.

Sealants are not generally recommended where surfaces are accessible to physical damage such as low ceilings in corridors and stairways. Table 6.2.1 is useful in determining whether encapsulation is an appropriate control method.

(Appendix B provides additional information about sealants.)

6.3 Enclosure

Enclosure of a sprayed asbestos surface places a barrier between the asbestos-containing material and the area of activity. Either a suspended barrier or an attached lath system is usually used. Depending upon the integrity and type of barrier system, a dissemination of fibres by fallout will take place behind the barrier only, and exposures below the barrier will be greatly reduced.

Contamination from contact will theoretically be prevented by the barrier. A barrier system must not

SELECTION OF A CORRECTIVE ACTION METHOD

TABLE 6.0.1

Method	Advantages	Disadvantages	When Method is Appropriate	When Method is Inappropriate
Removal	Eliminates asbestos source Ends exposure	Usually most costly and complicated method Usually most time consuming method Replacement with substitute material may be necessary Higher potential for worker exposure	High exposure Material is deteriorating or damaged Material is accessible Flat, open material surface	Removal is not feasible because of cost, location of material and kind of surface to which it has been applied (e.g., removal of material from complex surfaces such as pipes, lines, and ducts)
Encapsulation	Controls exposure Usually most rapid and economical method Some thin acoustic materials can be fully penetrated by sealant and rendered non-friable	Asbestos source remains If material is damaged or deteriorating, additional weight of the sealant may cause delamination ¹ Management system required. Precautions necessary to prevent damage during maintenance or renovation Continuing inspection required to check for damage to encapsulated surface Maintenance on damaged or deteriorating encapsulated surface required Encapsulated material is difficult to remove Encapsulation may affect fire rating.	Removal not feasible Material still retains bonding integrity Damage to material not probable Limited accessibility of material Complex surfaces to be covered Economic or time advantage	Removal feasible Material does not adhere well to substrate ² Weight of sealant may cause delamination Damage to material is probable Water damage Continuing inspection and maintenance of encapsulated material doubtful
Enclosure	Controls exposure May be most rapid, economical, uncomplicated method	Asbestos source remains Fibre fallout continues behind enclosure May be costly if enclosure disturbs functions of other systems (e.g., enclosure may require lighting changes) Management system required. Precautions necessary for entry into enclosure for maintenance or renovation Continuing inspection required to check for damage to enclosure system Maintenance on damaged enclosure system required	Removal not feasible Disturbance or entry into enclosed area not likely Economic advantage Building design allows installation of barrier	Removal feasible Damaged or deteriorating material causing high levels of fibre fallout Water damage Damage to enclosure likely Entry into enclosure probable for repairs and maintenance Continuing inspection and maintenance of enclosure doubtful
Deferred Action or Management and Custodial Control	No direct cost	Potential for exposure may increase Management system required. Precautions necessary to prevent damage during maintenance or renovation Continuing inspection and re-evaluation necessary	Negligible exposure potential As an interim measure prior to implementation of other corrective action.	Definite or questionable exposure potential Continuing inspection doubtful

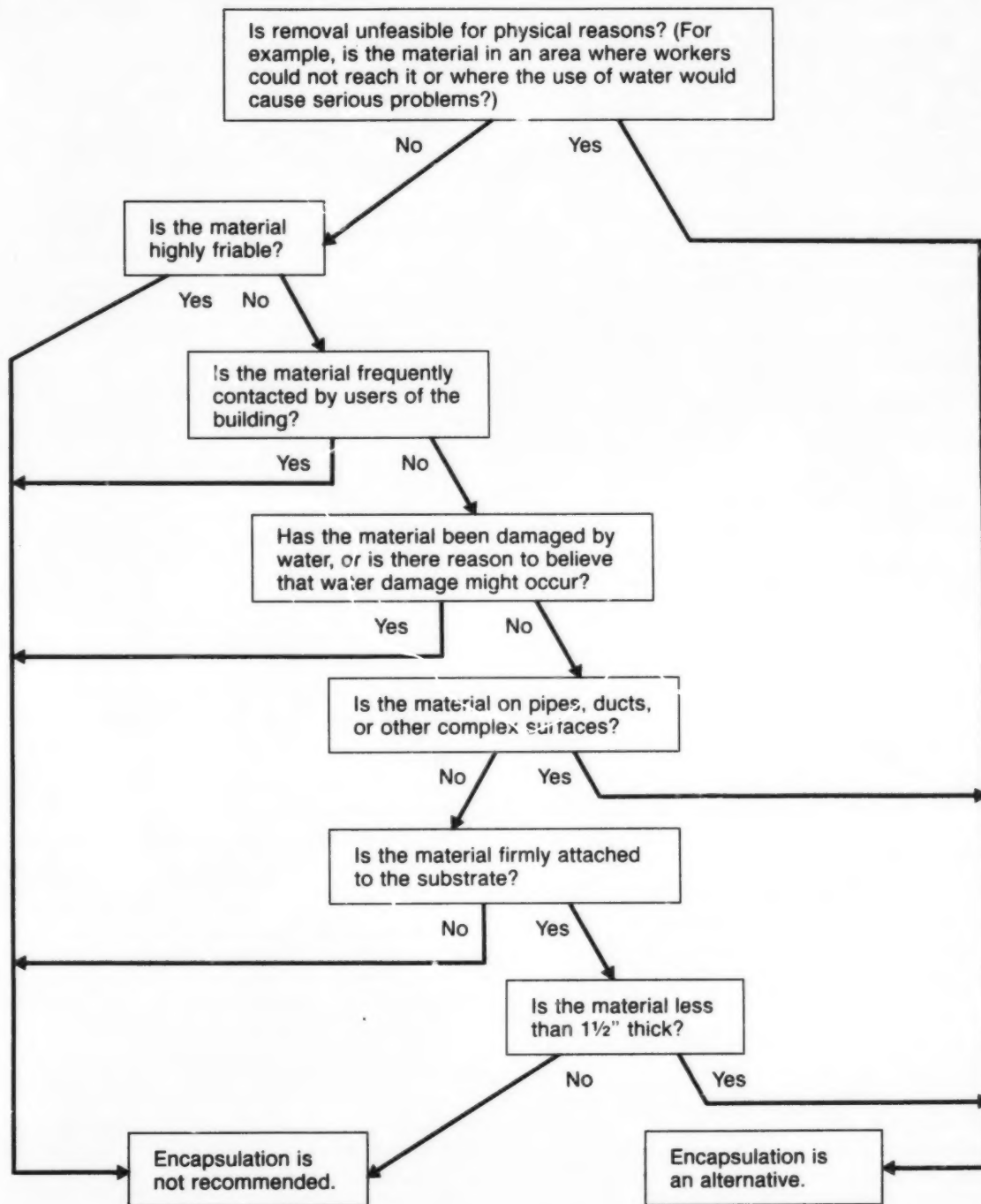
¹ Delamination is the breaking away of layers of material from the underlying surface.

² Substrate is the surface to which the asbestos material was applied (e.g., ceilings, steel beams, pipes).

Reprinted from: U.S. Environmental Protection Agency, "Asbestos-containing Materials in School Buildings: A Guidance Document Part 1," March 1979

TABLE 6.2.1

APPROPRIATE SITUATIONS FOR ENCAPSULATION



Reprinted from: U.S. Environmental Protection Agency, "Draft Guidelines for the Use of Sealants on Asbestos-containing Materials", June 1980

connect with an air plenum system, and the enclosed space should not communicate in any way with other portions of the occupied building.

Installation of hangers or lath may necessitate contact and penetration of the asbestos material and will result in asbestos fibre release. Consequently, worker exposure protection is required during this work. Furthermore, loose fibre accumulation behind the barrier will continue. Consequently, entry into these areas will require protection and fibre containment precautions.

The uncertainties in its long-term effectiveness, the need for continued monitoring and the remaining problems at the time of demolition or renovation make this method unattractive.

7.0 REMOVAL PROCEDURE

All work performed must comply with the industrial health and safety regulations of the Workers' Compensation Board.

7.1 Wet Removal

7.1.1 Precautions and Preparations

1. Written instructions must be provided to all employees, detailing the required stripping (removal) procedure. (W.C.B. I.H.&S. REG. 8.18)
2. A qualified supervisor must be at the work site at all times to ensure that work procedures are executed properly. (W.C.B. I.H.&S. REG. 8.20)
3. All furniture and other movable objects must be removed from the stripping area. Non-transportable objects must be completely enclosed with heavy duty polyethylene sheeting. It should be noted that in situations of deteriorating asbestos surfaces such activity may result in contact and re-entrainment contamination to significant levels, and personal protection should be used.
4. All supply and return air vents from the heating and ventilation system must be effectively blocked off to prevent air flow and be adequately sealed with polyethylene sheeting. The ventilation system should be checked to see if blockage would adversely affect the system. Where possible the entire ventilation system should be inoperative.
5. The removal area must be isolated and access restricted to authorized personnel. This is done by sealing corridors and entry ways with polyethylene barriers. The decontamination area should be set up at this time. (See section 8.0 "Decontamination Procedure".)
6. All "authorized personnel" must be fully informed of the adverse health effects of asbestos.
7. Notices must be posted around the perimeter designating the area as restricted.
8. Clean, fullbody coveralls (e.g., disposable coveralls), rubber boots or easily decontaminated footwear, caps and gloves as well as eye protection and hard hats as necessary must be provided by the employer (contractor) and worn by all employees entering the

work area. Clean coveralls shall be provided at least daily.

9. Approved respirators (see Appendix A) must be provided by the employer and worn by all employees entering the work area in addition to the above mentioned protective clothing. All employees must be thoroughly familiar with the correct use and limitations of the respirators.
10. Removal of surface mounted objects such as lights, partitions and other fixtures should precede the actual asbestos removal operation. This will usually result in contact with the ceiling with significant exposure potential. Localized water spraying during fixture removal will reduce fibre dispersal.
11. A separate ventilation system should be installed to maintain a slight negative pressure in the removal area. This should ensure that contaminated air does not migrate to adjacent areas of the building. The exhaust air must be vented to the outside via an effective two-stage air cleaning device (i.e., a prefilter, followed by a HEPA filter).
12. Provisions must be made for the drainage or cleanup of the excess water associated with the wet method. These provisions depend upon the nature of the work area.
13. Plastic bags of a minimum thickness of 6 mil must be obtained for disposal of the asbestos containing material and contaminated clothing, etc. The plastic bags should be sealed and placed into sturdy containers (i.e., drums with lids) or double bagged.
14. At the end of the workshift, workers must remove work clothes, leave them at the work site and shower before changing into street clothes.
15. The provision of toilet facilities, such as a chemical toilet, may be necessary, in the equipment room (located adjacent to the workroom).

7.1.2 Stripping Procedure

1. Completely wet down and thoroughly soak the asbestos-containing material. Coverings impervious to water must be pierced to allow soaking.
2. Suitable wetting agents or surfactants are to be used.
3. Remove the soaked material by scraping or by similar means, in a systematic fashion, working from one end of the work area to another. No sandblasting or other abrasive techniques are permitted. Asbestos-containing material should be placed directly into the plastic bags, not allowing the fibres to become airborne or allowing a buildup of materials on the floor. All loose material must be placed into the 6 mil plastic bags before it dries out.
4. The floor area should be kept damp to prevent fibres from becoming airborne.
5. Care should be taken to avoid the slipping hazard posed by the wet floor.
6. Workers must ensure that removal is complete and no asbestos-containing material remains on overhanging pipes or surfaces.
7. No smoking or eating is permitted in the work area or

decontamination areas, since this would require removal of respiratory equipment.

7.1.3 Clean-up Procedure

1. When asbestos stripping is complete all contaminated equipment, clothing, etc., must be thoroughly cleaned or disposed of in 6 mil plastic bags and labelled accordingly.
2. All exposed surfaces in the work area must be thoroughly cleaned. A thorough wet cleaning or vacuuming (2-stage, high-efficiency filter) of all floors and surfaces is necessary to ensure adequate cleanup. Vacuum refuse must be soaked and disposed of in plastic bags. Plastic sheeting is to be wiped down. (See section 9.0 "Transportation and Disposal of Asbestos-Containing Refuse").
3. Repeated cleaning cycles, using wet cleaning methods at intervals of 24 hours, is required to collect settled fibres. During the settling period, no entry, activity or ventilation will be allowed. A minimum of two such cleaning cycles is normally required.
4. Stringent visual inspection of the removal site should be made to ensure adequacy and completeness of the removal procedure.
5. Air sampling: Airborne asbestos sampling should be performed in consultation with the W.C.B., both during and following asbestos stripping operations. During stripping, sampling in the removal work area, outside containment barriers and within the decontamination area should determine the adequacy of contamination control. Air sampling will supplement post-removal visual inspections and establish the completeness of the removal process.

7.2 Dry Removal

Dry removal of untreated friable asbestos material is not recommended, but may be necessary in instances of unavoidable damage through the use of wet removal techniques. *Dry removal may only be undertaken with the approval of the local office of the Workers' Compensation Board.*

Dry removal results in high airborne asbestos contamination with fibre counts that can exceed 100 fibres/cc. The potential for worker, structure and community contamination is high and complete fibre containment by a series of barriers is necessary, along with an elaborate system for debris removal and worker decontamination.

All dry removal must be done under negative pressure relative to the rest of the building to prevent spread of dust. The area to be cleaned must be sealed off from other occupied areas and workers protected with suitable clothing and pressure demand face masks.

The exhausted air containing asbestos fibre must be suitably filtered before release to the atmosphere.

7.3 Encapsulation Procedure

7.3.1 Precautionary Measures

1. Individuals involved in the encapsulation procedure

must be fully informed of the adverse health effects of asbestos. They must be thoroughly familiar with the safe work procedures and the correct use and limitations of the respiratory protection.

2. A qualified supervisor must be at the work site at all times to ensure that work procedures are executed properly.
3. Furnishings in the work area must be removed or covered with heavy plastic sheeting.
4. All supply and return air vents must be blocked off to prevent spreading the fibres throughout the building.
5. Adequate provisions must be made to prevent dispersal of contaminants to adjoining areas. The use of plastic sheeting or a similar impervious material is considered acceptable. (See section 8.0.)
6. Only authorized personnel are to be in the work area. Notices must be posted around the perimeter of the area designating it as restricted.
7. All workers in the work area must wear suitable work clothing, an approved respirator and any other safety equipment as required for the situation.
8. The spraying must be carried out in accordance with the manufacturer's instructions and in such a fashion as to minimize damage to the asbestos-containing surface.
9. Sealants are to be applied using airless spray equipment at a low pressure setting. (See Appendix B for information on types and characteristics of sealants.)
10. It may be desirable in some cases to provide a slight negative pressure in the work area. The air exhausted to provide this negative pressure must be vented to the outside through an effective two-stage filter system (prefilter and HEPA filter).
11. No smoking or eating in the work area, since this would require removal of the respiratory protection.
12. At the end of the workshift, workers must remove work clothes, leave them at the work site and shower before changing into street clothing. All tools must be left in the work area.
13. Any debris which may have been dislodged during the spraying must be disposed of in a sealed container (6 mil plastic bag).
14. At the completion of the job, all equipment used must be thoroughly cleaned and work clothes placed in closed containers and laundered by personnel who are informed about the hazards of asbestos and the correct procedures to be used in laundering asbestos contaminated clothing.
15. All exposed surfaces must be cleaned. A thorough wet cleaning or vacuuming, with a two-stage, high-efficiency filter system must be carried out in the area. Vacuum refuse must be soaked and disposed of in plastic bags.
16. Caution must be taken when removing plastic sheeting, to prevent the release of fibres into the atmosphere. The sheeting must be wiped down, folded so that the contaminated side is inside and disposed of in plastic bags.

7.3.2 Post-Encapsulation Measures

1. All locations where encapsulation has been carried out shall be fully documented and, if necessary, signs posted warning of encapsulated asbestos, to ensure that adequate precautions will be taken if future alterations, renovations, maintenance or demolition occurs.
2. Periodic inspection of the encapsulated material is required to ensure damage has not occurred.
3. Any damage to the sealant will require immediate corrective action.
4. Custodial workers must be informed of safe cleaning procedures of the sealant surface to avoid damage.
5. Trades people, and other personnel performing repair work in the affected area, must be notified of the potential hazard from damaging sealant surfaces.

7.4 Enclosure Procedure

There are certain hazards involved in the process of enclosure of asbestos containing surfaces. The following precautionary measures must be followed:

7.4.1 Precautionary Measures

1. Individuals involved in the enclosure procedure must be fully informed of the adverse health effects of asbestos and must be thoroughly familiar with the safe work procedures, and the correct use and limitations of the respiratory protection.
2. A qualified supervisor must be at the work site at all times to ensure that work procedures are executed properly.
3. Furnishings in the work area must be removed or covered with heavy-duty plastic sheeting. All supply and return air vents must be blocked off to prevent spread of fibres throughout the building.
4. It may be desirable in some cases to provide a slight negative pressure in the work area. This should ensure that contaminated air will not migrate to adjacent areas. The air exhausted to provide this negative pressure must be vented to the outside, through an effective two-stage filter.
5. Adequate provisions must be made to prevent dispersal of contaminants to adjoining areas. The use of plastic sheeting or similar impervious material is acceptable. (See section 8.0.)
6. Only authorized personnel are to be in the work area. Notices must be posted around the perimeter of the area designating it as restricted.
7. All workers in the work area must wear suitable work clothing, an approved respirator and any other safety equipment as required.
8. The application of the enclosure should be carried out in such a fashion as to minimize the damage to the asbestos-containing surface.
9. Gypsum wallboard, metal or other suitable coverings which conform to the appropriate Building Codes are to be used to enclose asbestos-containing surfaces.

10. Suspended ceilings with removable panels are not acceptable as an enclosure, except when used in combination with encapsulation.
11. All joints or seams in the enclosing material must be effectively sealed to prevent escape of asbestos fibres.
12. Disposal of dislodged material should be undertaken with caution. All material must be disposed of in labelled 6 mil plastic bags. Large quantities must be wetted prior to placing in the plastic bags. (See section 9.0 "Transportation and Disposal of Asbestos-Containing Refuse.")
13. No smoking or eating in the work area, since this would require removal of the respiratory equipment.
14. At the end of the work shift workers must remove work clothes, leave them at the work site and shower before changing into street clothing. All tools must be left in the work area.
15. At the completion of the job all equipment used must be thoroughly cleaned and work clothes placed in closed containers and laundered by personnel who are informed about the hazard of asbestos and the correct procedures to be used in laundering asbestos contaminated clothing.
16. All exposed surfaces should be cleaned. A thorough wet cleaning or vacuuming, with a two-stage high-efficiency filter system must be carried out in the work area after completion of the enclosure. Vacuum refuse must be soaked and disposed of in plastic bags.
17. Caution must be taken when removing plastic sheeting to prevent fibre release. The sheeting must be wiped down, folded so that the contaminated side is inside and disposed of along with the refuse.

7.4.2 Post-Enclosure Measures

1. All locations where enclosure has been carried out shall be fully documented and if necessary, signs posted warning of enclosed asbestos, to ensure that adequate precautions will be taken if future alterations, renovations, maintenance or demolition occurs.
2. Periodic inspection of the enclosure system is required to ensure damage has not occurred to the enclosure's protective covering by building occupants, custodial workers, maintenance personnel, or others.
3. Any damage to the enclosure will require immediate corrective action.
4. Re-entry into enclosed areas must be kept to a minimum since the accumulation of loose fibres will continue behind the barrier. Other personnel should not be present in the immediate vicinity during re-entry.
(NOTE: If regular maintenance of equipment or some other purpose requires re-entry into the enclosure space on a regular basis, enclosure should not be used as a corrective measure.)
5. Workers re-entering the enclosure must be made aware of the adverse health effects of asbestos and

must be familiar with the safe work procedures, and the correct use and limitations of the respiratory protection.

6. Adequate provisions must be made to prevent asbestos fibre dispersal through the enclosure entry.
7. Workers re-entering the enclosure must wear suitable work clothing, an approved respirator and any other safety equipment as required.
8. The enclosure opening must be effectively sealed after any re-entry.
9. Effective worker decontamination and vacuuming (two-stage, high efficiency filtration) of the entrance area must follow any such re-entry.

8.0 DECONTAMINATION PROCEDURE

A decontamination area should consist of a number of rooms or spaces so connected that one passes in succession from one to another. Each room should be lined with plastic, sealed with tape at all lapjoints in the plastic. In all cases access between rooms or areas should be through a curtained doorway. A curtained doorway is a device to allow ingress or egress from one room to another while permitting minimum air movement between the rooms. A curtained doorway is typically constructed by placing two overlapping sheets of plastic over an existing or temporarily framed doorway, securing each along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway, and securing the vertical edge of the other sheet along the opposite vertical side of the doorway. There should be only one route into and out of a work area and this route must pass through the decontamination area.

8.1 Decontamination Areas

1. **Outside room (clean area):** In this room the worker leaves all street clothes and changes into clean working clothes (usually disposable coveralls). Respiratory protection equipment is also picked up in this area. No asbestos-contaminated item should enter the room. Workers enter the room either from outside the structure dressed in street clothes, or naked from the showers.
2. **Shower room:** This is a separate room used for transit by cleanly dressed workers entering the job from the outside room, or by workers headed for the showers after undressing in the equipment room. The room should be located adjacent to, or as close as possible, to the work area.
3. **Equipment room (contaminated area):** Work equipment, footwear, additional contaminated work clothing are left here. This is a change and transit area for workers. Toilet facilities, such as a chemical toilet, may be located in this room for the workers.
4. **Work area:** The work area should be separated by polyethylene barriers from the equipment room. If the airborne asbestos level in the work area is expected to be high, as in dry removal, an additional intermediate

cleaning space may be added between the equipment room and the work area.

8.2 Decontamination Sequence

1. Worker enters outside room and removes street clothing, puts on clean coveralls and respirator, and passes through into the equipment room.
2. Any additional clothing and equipment left in equipment room required by the worker is put on. (When the work area is too cold for coveralls only, the worker will usually provide himself with additional warm garments. They must be treated as contaminated clothing and left in the decontamination unit.)
3. Worker proceeds to work area.
4. Before leaving the work area, the worker should remove all gross contamination and debris from the overalls. In practise this is usually carried out by one worker assisting another.
5. The worker proceeds to equipment room and removes all clothing except respiratory protection equipment. Extra work clothing may be stored in the contaminated end of the unit. Cloth coveralls may be stored in the contaminated end of the unit. Disposable coveralls (if used) are to be placed in a bag for disposal with other contaminated material. The worker then proceeds into the shower room. Respiratory protection equipment should be removed last to prevent inhalation of fibres during removal of contaminated clothing.
6. After showering, the worker moves to the clean room and dresses in either new coveralls for another entry or street clothes if leaving.
7. Respirators are picked up, cleaned by washing and wrapped.

9.0 TRANSPORT AND DISPOSAL OF ASBESTOS-CONTAINING REFUSE

All asbestos-containing refuse must be contained in well sealed, 6 mil plastic bags. The plastic bags should be inserted into non-reusable, sturdy drums or containers (with lids) or double bagged. The containers must be labelled: "CONTAINS ASBESTOS. CANCER HAZARD. AVOID BREATHING DUST."

During loading and transporting of the refuse, care must be taken to avoid exposure to, or release of, the fibres. The transport vehicle must be enclosed, or covered securely with a tarpaulin.

The driver of the transport vehicle must be fully informed as to the hazards should any of the material become airborne. The driver must be provided with respiratory protection which is to be worn during emergencies or dumping when there may be an asbestos exposure.

Should leakage or spillage occur enroute, the material must be thoroughly soaked and repackaged. The workers performing the clean-up operation must be protected from inhalation of fibres by wearing approved respiratory protection.

All asbestos-containing refuse must be disposed of in a designated sanitary landfill site.

Dump operators in close proximity to the refuse must wear respiratory protection during unloading. The operators must be informed of the contents of the refuse. The refuse should be buried immediately.

Upon completion of the job, vehicles used in the conveyance of the friable asbestos refuse must be thoroughly washed.

For further information on suitable landfill sites for disposal of asbestos, contact:

Ministry of Environment
Waste Management Branch

Regional Offices:

Victoria	387-4321	Nelson	352-2211
Vancouver (Surrey)	584-8822	Nanaimo	758-3951
Kamloops	374-9717	Penticton	493-8261
Prince George	563-1181	Williams Lake	392-6261

APPENDIX A

Protective Equipment

A.1 Respiratory Protection

Respirators shall provide adequate employee protection from airborne asbestos fibres and shall be maintained in good working order in accordance with the manufacturer's instructions. The protective respiratory equipment shall meet the requirements of the Workers' Compensation Board of British Columbia. Equipment meeting NIOSH and MSHA standards are considered acceptable. Table A.1 identifies acceptable respirator types depending on the expected airborne fibre concentration for asbestos removal, encapsulation, or enclosure operations.

TABLE A.1

Asbestos Time Weighted Average (TWA) versus Acceptable Respirator Types

Asbestos Concentration (Fibres/cc)	Min. Acceptable Respirator Type
Less than 20 fibres/cc chrysotile Less than 2 fibres/cc (amosite or crocidolite)	Replaceable filter-type air purifying dust respirator
Less than 100 fibres/cc chrysotile (less than 10 fibres/cc amosite or crocidolite)	Air purifying, powered respirators
Above 100 fibres/cc chrysotile (above 10 fibres/cc amosite or crocidolite)	**Air supplied respirators or self-contained breathing apparatus

* Wet Removal, Encapsulation and Enclosure procedures probably result in a time weighted average concentration of less than 20 fibres/cc. During enclosure of surfaces which are in poor condition, or during removal of material that has been painted or sealed, fibre levels may be considerably higher.

**During dry asbestos stripping, high airborne asbestos fibre concentrations can be anticipated, therefore, the use of an air supplied respirator or self-contained breathing apparatus is recommended.

Every worker who is required to use respirators shall be given pre-job instruction by the employer to understand its use, limitations and maintenance requirements. Workers required to use a respirator shall be clean-shaven where the respirator seals with the face.

Air-supplied respirators or self-contained breathing apparatus must meet and be operated in accordance with the Workers' Compensation Board's "Industrial Health & Safety Regulations" - Sections 14.23 and 14.25.

Regardless of the kind of respirator used, each wearer must be tested to ensure that the respirator gives a satisfactory seal to the face.

A.2 Other Protective Equipment

In addition to respiratory protection, all persons entering an active asbestos removal, encapsulation or enclosure work area shall wear the following protective equipment:

1. Full-body coveralls and head covers (preferably disposable coveralls).
2. Rubber boots or easily decontaminated footwear, or disposable footwear.
3. Eye protection, where required.
4. Hard hats, as required.
5. Gloves.

APPENDIX B - SEALANTS

B.1 Types of Sealants

If the decision to encapsulate has already been made, the next question is whether to use a bridging or penetrating sealant. A bridging sealant works by forming a tough membrane over the surface of the asbestos-containing material which should prevent the release of any asbestos fibres. A penetrating sealant is designed to soak into the material.

The use of a penetrating sealant does not guarantee success. Unless the sealant penetrates all the way to the substrate (underlying surface), it will contribute nothing to substrate bonding. Since most penetrating sealants do not penetrate more than an inch into spray-applied asbestos material, they are unlikely to bind thicker asbestos-containing materials to the substrate.

Penetrating sealants tend to impair the thermal insulating properties of asbestos-containing material more than bridging sealants. Asbestos-containing material insulates heat well because of the dead air spaces in the material. While a good penetrating sealant will not completely fill all these gaps, any penetrating sealant reduces the amount of dead air space in the material. Where the thermal insulating properties of the material are important, a bridging sealant is likely to be preferable.

Asbestos-containing material which serves as acoustical insulation is likely not to function as well after any sealant has been applied. Asbestos-containing material absorbs sound because of its dead air spaces and because of its irregular surface. Penetrating sealants reduce the dead air space, while bridging sealants create a smooth layer on the surface. Either will impair the material's acoustic properties to some extent.

On complex surfaces involving numerous beams, pipes and ducts, a bridging sealant may be preferable. It will wrap around the irregularities in the surface, enveloping the material and binding it within the continuous membrane of the sealant.

Penetrating sealants are not suitable for use on material which has already been encapsulated or painted. They cannot penetrate the water-tight surface formed by the old coat of sealant or paint.

Table B.1 compares properties of bridging and penetrating sealants.

B.2 Sealant Characteristics

An effective sealant should possess the following characteristics:

- The sealant should eliminate fibre release by adhering to the sprayed asbestos material.
- It should withstand most impact and penetration and still protect the enclosed sprayed asbestos material.
- It should possess enough flexibility to accommodate atmospheric changes and settling of the structure over time.
- It should have high flame-retardant characteristics and a low toxic fume and smoke emission rating.

- It must be easily applied by non-specialized personnel. Ease of repair by routine maintenance personnel is desirable.
- The sealant must be neither noxious nor toxic to application workers and building users.
- It should have some permeability to water vapour to prevent condensation accumulation, and resistance to common cleaning agents.
- It should have suitable stability to weathering and aging.
- It should be acceptable by architectural and aesthetic standards.

COMPARISON OF BRIDGING AND PENETRATING SEALANTS

	Bridging Sealant	Penetrating Sealant
Pigmented for aesthetic improvement?	Yes	No
Improves cohesive strength of material (i.e., reduces friability)	No	Yes
Improves adhesion of material to substrate?	No	Sometimes
Appropriate for water-damaged material?	No	No
Impairs thermal insulating properties of material?	No	Yes
Impairs acoustic insulating properties of material?	Yes	Yes
Preferable for material on pipes and ducts?	Yes	No
Preferable for cementitious material?	Yes	No
Appropriate for material which has already been painted or encapsulated?	Yes	No

Reprinted from: United States Environmental Protection Agency, "Draft Guidelines for the Use of Sealants on Asbestos-containing Materials," June 1980

APPENDIX C

For further information about this program in general,
bulk sampling, and exposure assessment contact:

OCCUPATIONAL ENVIRONMENT BRANCH REGIONAL OFFICES

BURNABY OFFICE

4946 Canada Way
Burnaby, BC V5G 4J6
291-9494

CHILLIWACK OFFICE

45904 Victoria Avenue West
Chilliwack, BC V2P 2T1
792-0634

KELOWNA OFFICE

1626 Richter Street
Kelowna, BC V1Y 2M6
860-0801

KAMLOOPS OFFICE

546 St. Paul Street
Kamloops, BC V2C 2J9
374-7106

NANAIMO OFFICE

238 Franklyn Street
Nanaimo, BC V9R 2X4
753-9185

NELSON OFFICE

310 Ward Street
Nelson, BC V1L 5S4
352-2211 L453/456

PRINCE GEORGE OFFICE

1011 Fourth Avenue
Prince George, BC V2L 3H9
562-8131 L356

TERRACE OFFICE

4548 Lakelse Avenue
Terrace, BC V8G 1P8
638-8191

VICTORIA OFFICE

880 Douglas Street
Victoria, BC V8W 2B7
387-5771

For further information about instituting long term
control measures (removal, encapsulation, or enclosure)
contact:

WORKERS' COMPENSATION BOARD OF B.C.

VANCOUVER OFFICE

6951 Westminster Highway
Richmond, BC V7C 1C6
273-2266

CHILLIWACK OFFICE

Ste. 21 8635 Young Street
Chilliwack, BC V2P 4P2
792-0751

CRANBROOK OFFICE

100 - 7 Avenue S.
Cranbrook, BC V1C 2J4
426-6694

COURTENAY OFFICE

426 - 8 Street
Courtenay, BC V9N 1N5
338-5484

FORT ST. JOHN OFFICE

9512 - 100 Street
Fort St. John, BC V1J 3X6
785-8371

KAMLOOPS OFFICE

627 Victoria Street
Kamloops, BC V2C 5T4
374-5621

NANAIMO OFFICE

420 Albert Street
Nanaimo, BC V9R 2V7
754-4431

NELSON OFFICE

327 Baker Street
Nelson, BC V1L 4H6
352-2291

PENTICTON OFFICE

257 Brunswick
Penticton, BC V2A 5P9
493-2024

PRINCE GEORGE OFFICE

299 Victoria Street
Prince George, BC V2L 5B8
563-9264

PRINCE RUPERT OFFICE

222 - 3 Avenue W.
Prince Rupert, BC V8J 1L1
624-6721

TERRACE OFFICE

4450 Lakelse Avenue
Terrace, BC V8G 1P2
635-6536

VICTORIA OFFICE

320 Cook Street
Victoria, BC V8V 4W1
381-2223

VERNON OFFICE

3306 - 32 Avenue
Vernon, BC V1T 2M6
545-4401

WILLIAMS LAKE OFFICE

302 - 383 Oliver Street
Williams Lake, BC V2G 1M4
392-2376

